WMO Workshop
"Use of NWP for Nowcasting"

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Workshop "NWP in support of nowcasting"

WMO initiative

Aims:

➔ Strengthen interaction between NWP and NWC communities

➔ Confront present and future prospects of NWP for NWC with challenges of NWC, recommendations on way forward

- Workshop held in October 2011, Boulder.
- ~45 participants

What is nowcasting?

"Description of current state of the weather in detail and the prediction of changes in a few hours"

Browning, 1981

- 0-6h forecasting by any method

  0-2h: nowcasting in the strict (WMO) sense

  0-12h: very short range forecasting (WMO)

- Spatial scale of no more than a few (1-3) km, with frequent updates (5-10min)

- Heavy emphasis on observations

According to this definition, mesoscale NWP is moving into the nowcasting range.   BUT…

THORPEX

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    Formulated in terms of user impact, easy to understand and interpret, and generally highly user-specific

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- With a very fast time-to-delivery

  Within minutes: "Nowcasting is relevant not because it is better but because it is fast"

Situation Chart for CYYZ

TAF Plus | SIMCOE | WATERLOO | LINNG | MANS

Rwy: ☑ 05/23 ☑ 06/24RL ☑ 15/33RL

Thresholds — CYYZ METEOROLOGICAL NOWCAST : VALID AT 2011-02-02 10:00 UTC [INTW, GEM_REG_MOLTS, GEM_LAM_MOLTS, RUC, OBS, M300]

	10:00	10:10	10:20	10:30	10:40	10:50	11:00	11:10	11:20	11:30	11:40	11:50	12:00	13:00	14:00	15:00	16:00
	OBS	+10m	+20m	+30m	+40m	+50m	+1h	+1:10h	+1:20h	+1:30h	+1:40h	+1:50h	+2h	+3h	+4h	+5h	+6h
05/23 WINDS	050 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	040 17G23	030 17G24	040 16G24	040 14G22	040 12G23
06/24RL WINDS	050 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	040 17G23	030 17G24	040 16G24	040 14G22	040 12G23
15/33RL WINDS	050 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	030 17G23	040 17G23	030 17G24	040 16G24	040 14G22	040 12G23
VISIBILITY	3/4SM	1 5/8SM	1 5/8SM	1 5/8SM	1 5/8SM	1 5/8SM	1 5/8SM	1 3/4SM	1 3/4SM	1 3/4SM	1 7/8SM	1 7/8SM	1 7/8SM	2 1/4SM	2 3/4SM	3SM	P6SM
CEILING	007	009	009	009	009	009	009	008	008	008	007	007	007	009	012	009	009
SHEAR/TURB																	
PRECIP	T	T	T	T	0004	0008	0007	0007	0007	0006	0006	0008	0020	0004	0002	T	0003
TSTM & LTNG																	
ICING						068	050	043	043	036	036	030	030	043	036	030	036

Thresholds — CYYZ OPERATIONS NOWCAST : VALID AT 2011-02-02 10:00 UTC [INTW, GEM_REG_MOLTS, GEM_LAM_MOLTS, RUC, OBS, M300]

|	10:00	10:10	10:20	10:30	10:40	10:50	11:00	11:10	11:20	11:30	11:40	11:50	12:00	13:00	14:00	15:00	16:00
	OBS	+10m	+20m	+30m	+40m	+50m	+1h	+1:10h	+1:20h	+1:30h	+1:40h	+1:50h	+2h	+3h	+4h	+5h	+6h
WX-ONLY AAR		62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62
CAT LEVEL	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
05/23 COND																	
06/24RL COND																	
15/33RL COND																	

Nowcasting methods are based on:

- Extrapolation of observations

- Very short range forecasts from NWP models

- Blending of observation extrapolation and NWP methods, in physically, statistically or rule-based ways
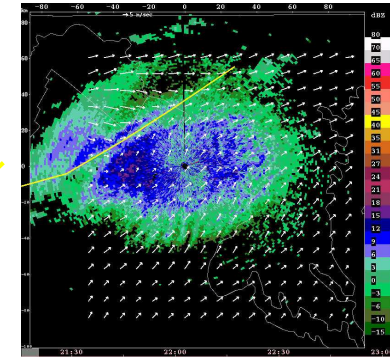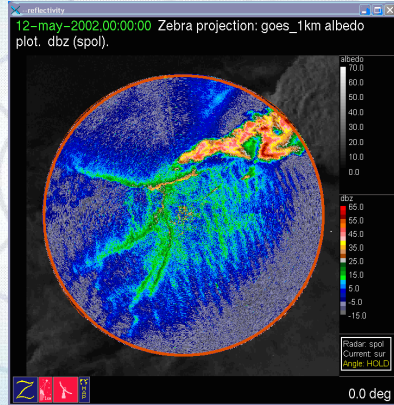
Extrapolation
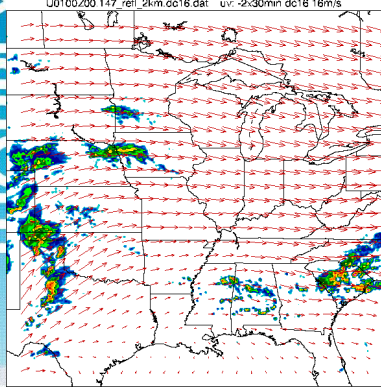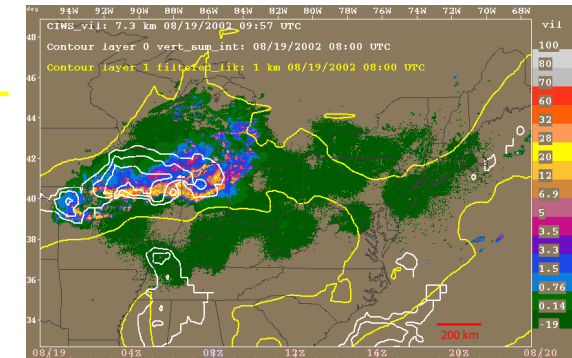
Statistical
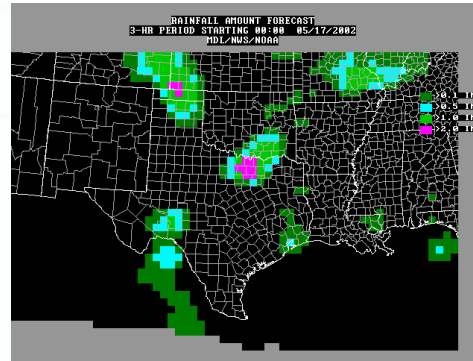
Radar retrievals
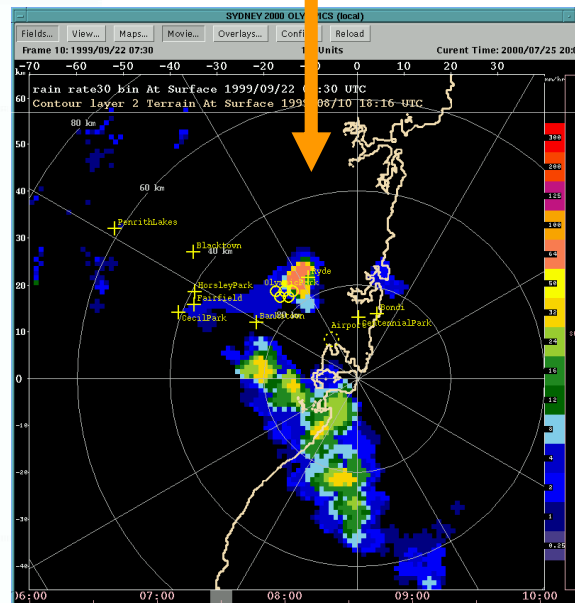
Convergence line
Detection & characterization

Model derived forecast fields

Forecast System

Nowcast

NWP

Forecast Rules

INITIATION
- Convergence line present
- LI < 0
- Cu in lifting zone

lifting zone
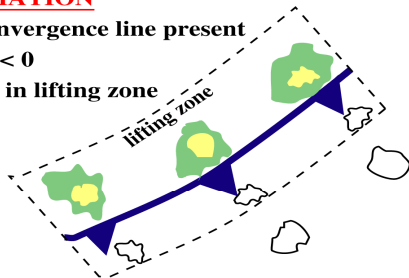
- Deep erect updrafts
  - convergence magnitude
  - low-level shear
  - boundary relative cell speed
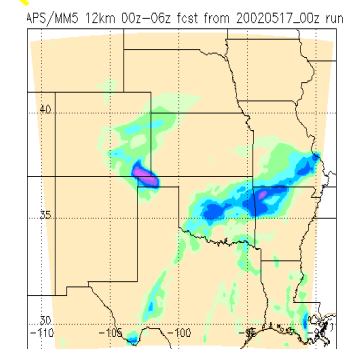
Courtesy, Jim Wilson NCAR

Problems for (deterministic) mesoscale NWP as "direct" nowcasting tool

- Not spatially/temporally detailed enough
- Not accurate enough (outperformed by other methods)
- Not timely/frequently enough
- Not providing requested kinds of information
- Not providing information on forecast uncertainty
- Not providing information in a form which a user can base a (fast) decision on

VOG: 2010-02-25 15:30 UTC
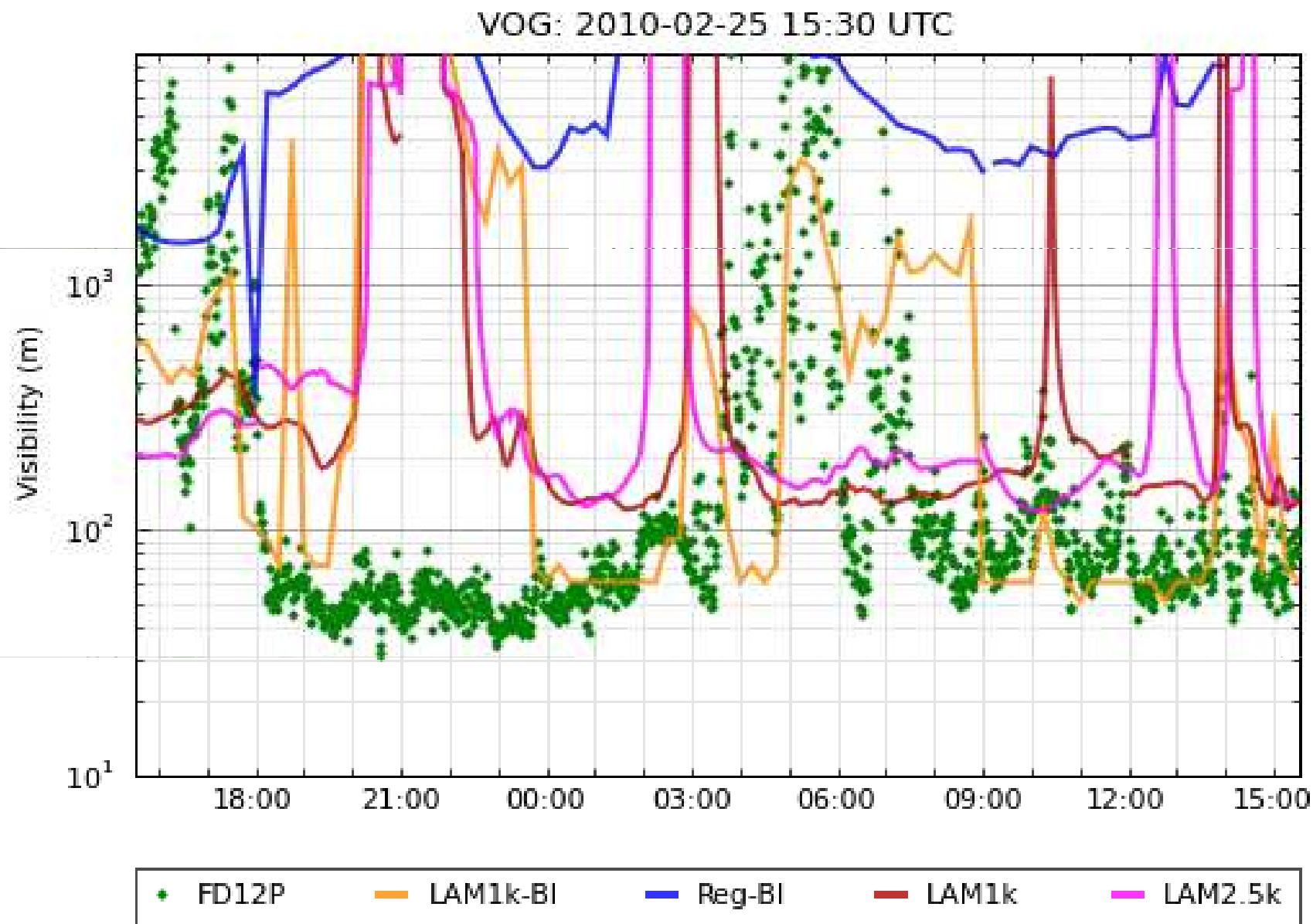
Experiences with mesoscale VSR NWP

- Advanced DA techniques and RUC/RR analysis really help
- Radar DA becoming mature, critical data source but more emphasis on other obs types would be welcome (BL, lidars, …?)!
- Need for sophisticated assimilation algorithms able to deal with flow-dependent background errors, phase/displacement errors
- Forecast model error is critical. Focus more on (stable) BL, surface!
- Forecast performance should be assessed for wider range of parameters: Humidity, cloud base/visibility, wind direction, BL vertical structure often <u>poorly described</u>.
- Performance especially problematic if large scale forcing is inaccurate
- NWP model often has "correct general picture", but structures can be misplaced, quantitative precision limited
- Difficult to beat obs extrapolation at fc times less than ~2h (or more for some parameters). Isztar Zawadski:
  "NWP has no real skill (compared to radar) at scales < 100km"
- Ensemble nowcasting presently based on perturbing obs. NWP can add physics to this.Uncertainty on actual predictability limits.

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State of the art in blending systems

- Various approaches:
  - ➤ Lagrangian-based extrapolation, feature tracking, …
  - ➤ Include aspects of convective growth/decay
  - ➤ Interpolation to high-resolution topography
- Blending observation extrapolation methods and NWP generally does improve upon NWP when localized forecasts are needed (e.g. steep terrain)
- Blending natural way of improving NWP skill in first two hours (might be difficult to do otherwise)

(Jim Wilson 2006, US-Korea Workshop)
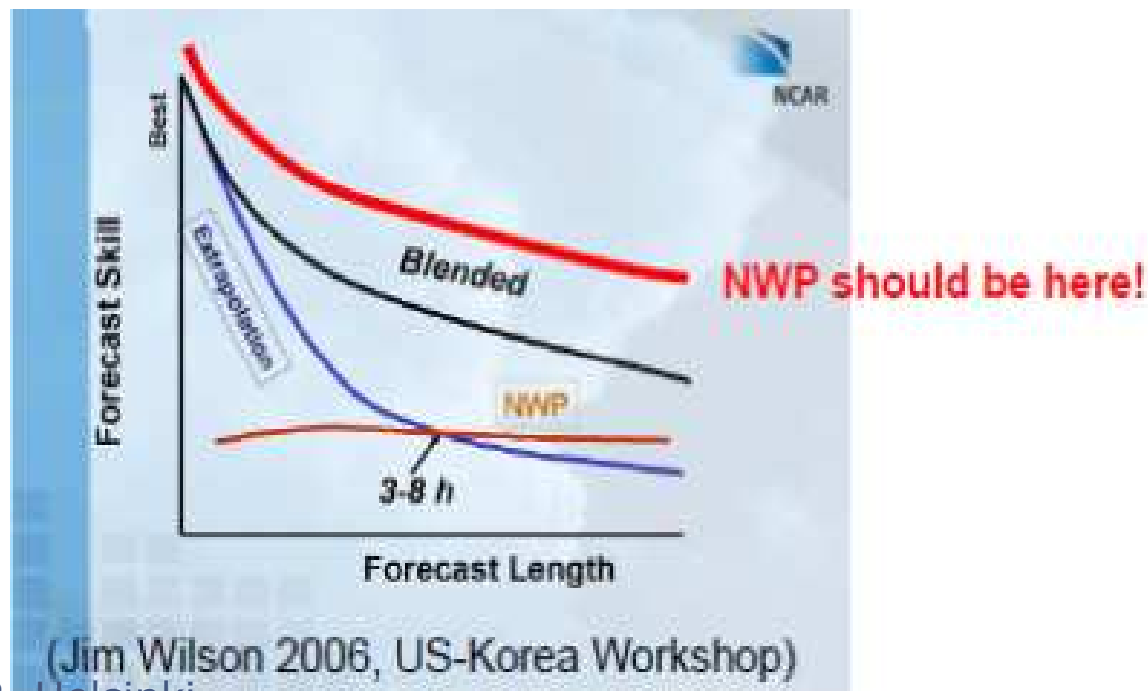
Site	TEMP	RH	WS	Gust	VIS	CEIL	PR
VOA	L1K	L1K	L1K	L1K	L1K		L2.5K
VOB	L2.5K	L1K	NO	L1K			
VOC	L1K	REG	L1K	L1K	NO	L1K	L2.5K
VOD	L1K	L2.5K	L2.5K	L1K			
VOE	L1K	L1K	L1K	L2.5K			
VOG	L1K		L1K	NWP	L1K	L1K	REG
VOI	L1K	L2.5K	NO	L1K			
VOL	L1K	L2.5K	REG	L2.5K	L2.5K		L2.5K
VOT	L1K	L2.5K	NO	L1K	L1K		L2.5K
VOW	L2.5K	L1K	L1K	L1K			
VOX	L1K	L2.5K	L2.5K	L1K			
WGP	L2.5K	REG	L1K	L2.5K		L1K	
WSK	L2.5K	L1K	L1K	L1K		L1K	
WWA	L2.5K	L1K	L1K	L2.5K		REG	
YVR	REG	L1K	L2.5K	NWP	NO	REG	L2.5K

NWP Model with Highest HSS Score During SNOW-V10 (0-6h)

LAM 1km -   40
LAM 2.5km - 23
GEM-15km -   7

INTW and NWP Models with Highest HSS in SNOW-V10

Site	TEMP	RH	WS	Gust	VIS	CEIL	PR
VOA	INTW	INTW	INTW	INTW	INTW		INTW
VOB	INTW	INTW	INTW	INTW			
VOC	INTW	INTW	INTW	INTW	INTW	INTW	INTW
VOD	INTW	INTW	L2.5K	INTW			
VOE	INTW	INTW	INTW	INTW			
VOG	INTW		INTW	INTW	INTW	INTW	INTW
VOI	INTW	INTW	INTW	INTW			
VOL	INTW	INTW	INTW	INTW	INTW		INTW
VOT	INTW	INTW	NO	INTW	INTW		INTW
VOW	INTW	INTW	INTW	INTW			
VOX	INTW	INTW	INTW	INTW			
WGP	INTW	INTW	INTW	INTW		INTW	
WSK	INTW	INTW	INTW	INTW		L1K	
WWA	INTW	INTW	INTW	INTW		INTW	
YVR	INTW	INTW	INTW	INTW	NO	INTW	INTW

User-dependent aspects

- For nowcasting purposes, NWP output needs to be <u>tailored towards user needs</u>:

  - ➤ Wider range of products needed, with much higher time, horizontal and vertical resolution than at present! Need for phys/stat postprocessing to highly localized products remains

  - ➤ Information on uncertainty in forecast is strongly requested !!

  - ➤ More focus required on (improving forecast skill for) high-impact weather

  - ➤ User needs assessment of weather <u>impact</u>, but this is complicated to determine

  - ➤ Complete the forecast: User needs quick way to interpret NWP data in own context => user-specific product generation on top of VSR NWP

  - ➤ Role of human forecaster: guardian of quality or (mostly or only) interpreter aiding users in their decisions?

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Outcome

Outbreak brainstorm sessions on ways to improve the usefulness of NWP in nowcasting through:

- Data assimilation developments
- Forecast model developments
- Blending techniques

BAMS article on workshop outcome in the making

WMO Nowcasting Symposium, 6-10 August 2012, Rio de Janeiro: Strong presence of/ input by NWP community.